CHAPTER 13, SECTION 3

MOLD CLEANUP, REMEDIATION, AND CLEARANCE SAMPLING

INTRODUCTION

The previous section stressed that prevention is the best policy: if water doesn't get into the building, mold won't grow. However, if you do find mold, it is crucial that you know how to safely and effectively remove the contamination and to assess the project success. Be prepared to review contract requirements, oversee the remediation, or liaise with occupants about associated concerns.

This section is a compilation of the most widely practiced mold remediation guidance, using the New York City (NYC) Department of Health guidelines as the foundation. Originally issued in 1993 specifically for *Stachybotrys* remediation, these guidelines were expanded in 2000 to cover all mold remediation in indoor environments. Information from the EPA's *Mold Remediation and Schools and Commercial Buildings* and several Canadian documents is also incorporated.

"RULES" FOR RESPONSE AND REMEDIATION

1. **Act Quickly**. Rapid response and proper actions following water damage are essential to significantly reduce or even prevent microbial damage.

Ideally, response actions following water intrusion should begin within 8 hours. Response within 24 hours will usually prevent mold growth. If actions are not underway within 48 hours, chances are good that mold will grow in or on water damaged materials and remediation will be needed.

2. **Locate and Fix Water Intrusion Source(s)**. This is essential to stop additional water infiltration and damage. Make repairs before or concurrent with removing water and drying the area.

Likely sources to check as water intrusion points include: the roof (missing or damaged shingles/finish or flashing); loose or damaged soffitts and gutters; chimneys; through-roof pipes or vents; improperly sloped drains; improperly vented appliances, uncontrolled humidity (i.e., moisture condenses on inside surfaces); improperly installed vapor/moisture barriers or surface finishes (e.g., exterior insulation and finish system [EIFS] or unsealed stucco); poorly fitted or sealed windows; crawlspace, slab or other foundation material (standing water or episodic incursion from rising water table); heating and cooling system; visible signs of flooding or recurrent water damage.

3. **Remove the Water and Protect Materials**. Water can be removed from hard surfaces by soaking it up or mopping. If large volumes of water are in the building, it may be necessary to

actively pump out standing water and/or use wet vacuums. Other actions that may be helpful for complete drying include:

a. Remove all wet carpet, rugs and padding.

b. Remove wall moldings (baseboard, decorative trim) to allow drainage if water has entered the wall cavity.

c. Drill holes in the wallboard to facilitate drying inside the wall cavities. Remove wet wallboard. This allows you to assess wall cavity damage, determine when structural components are dry, and removes a likely growth substrate for mold.

d. If built-in cabinets are wet, remove kick plates or drill holes for drying.

e. Check for water in the ventilation ducts, pipe chases, crawl spaces, basements, and attics.

Furnishings and other building contents that are not wet or damaged by the water intrusion should be moved temporarily to a dry location. If such items cannot be moved, protect them as much as possible, e.g., by covering in plastic if water is still leaking into the area or by elevating off the floor to remove from direct water contact.

If this is not possible, you might consider moving wet items to a separate dry location. This can decrease dry time since you aren't drying to dry out the furniture and the room simultaneously.

4**. <u>Dry the Area. Control Humidity and Temperature</u>**. Once excess water is removed, use fans/ air moving devices to promote evaporation and help drive off remaining moisture from furnishings and building materials. This step, in turn, increases the amount of moisture in the air, which must be removed by using dehumidifiers or by actively exhausting air outside. Take care to ensure that partially dried areas and/ or those not initially damaged by water are stabilized as other wet areas are being processed. Ideally, maintain relative humidity at 30-50%.

If weather permits, move wet furnishings outside to help with drying.

Do not use any building ventilation systems unless you have confirmed that they are not damaged, contaminated, or electrically compromised (wiring damage or electrical hazards).

There are two basic types of drying systems: open and closed. An open or natural dehumidification system exchanges the moist air inside the structure with dryer air from outside. For example, if outside conditions are favorable (i.e., relative humidity less than about 40% with moderate temperatures), opening windows and doors and continuously ventilating the area with air movers, building exhaust fans and/or ceiling fans will speed the drying process.

A closed or mechanical system uses equipment to remove the evaporated water from the remediation area. Be careful to ensure that the dehumidification rate does not go below the evaporation rate or you will slow drying time and may actually cause additional damage.

Controlling the temperature in the building will enhance both evaporation and dehumidification efforts.

You should routinely check the temperature, relative humidity, and material moisture to monitor drying progress. A moisture meter is essential for determining the status of structural components and furnishings.

5. **Clean the area. Remove Mold if Required.**

a. Once water is removed, assess remaining structural materials and building contents to determine what can be saved. The general rule is to remove all porous materials that were/are wet or damaged. Use a mild detergent and water solution to clean non-porous materials.

b. If mold is visible or materials have been wet longer than 48 hours, more extensive actions are needed to ensure that mold is completely removed and unlikely to reappear. Mold removal plans must be approved by the cognizant industrial hygiene, safety, and facilities personnel.

c. As a minimum, the plan should specify exactly what will be done during remediation, how it will be accomplished, acceptable criteria for reoccupancy, required sampling procedures and how to interpret results. For example, include detailed removal procedures; protective equipment for remediators; type of containments; contaminated material disposal; special cleaning requirements (books, carpet): sampling method(s) and interpretation criteria if sampling is required; employee relocation requirements if needed; and risk communication plan (e.g., meetings with employees, method and frequency of status reports to employees and management, points of contact).

d. **The cleanup and remediation guidance in this section applies only when the contamination results from clean water intrusion**, such as broken water supply lines, roof or window leaks, or condensate from high relative humidity. Cleanup of gray water (contains some contamination, e.g., dishwasher or washing machine overflows; toilet overflow (no feces)) or black water (unsanitary, pathogenic water source, e.g., sewage; storm flooding) requires more extensive procedures and protection because of the unsanitary conditions.

e. All procedures discussed in this section are minimum recommendations for cleaning and/or decontaminating materials that have been subjected to water damage, including building contents, ventilation systems, and structural components. The investigative team may recommend more stringent procedures based on actual conditions at the site.

f. **Killing mold is not sufficient. Because residual biomass can still elicit allergenic responses from sensitive individuals, mold must be removed.**

6. **Ensure Personnel Protection and Communication**.

a. Protect personnel, including occupants and cleanup/ remediation personnel. A successful remediation means that all mold, spores, and dusts are removed without exposing

personnel or releasing any of the contamination to other parts of the building or to the environment. Protection is discussed in detail later in this section.

b. Communicate. A critical component of the assessment phase was open and honest communication and information exchange between the investigators, managers, and occupants. This is even more important during remediation. People need assurance that their work environment is safe and that they are not exposed to the mold during cleaning or removal procedures. Inform occupants of exactly what will occur during remediation and what precautions are in place to protect them.

7. **Follow up.** After cleanup/ remediation is complete, revisit the area periodically to ensure that leak repairs were effective, materials are still dry, occupants have no complaints, and mold has not returned.

CLEANING AND REMEDIATION PROCEDURES

1. General Considerations

a. In most cases, at least some kind of cleaning will be required following water infiltration. Even with quick response actions, the area will have to be dried out and surfaces wiped down to prevent mold growth. If mold is visible, it must be completely removed. This can be as simple as washing and HEPA vacuuming, or as complex as demolition and reconstruction.

b. Successful cleaning requires an understanding of the location of contamination and the reason why fungal growth initially occurred. The more extensive the moisture damage, the more likely it is that you need to look for hidden mold colonization. Thus it may be necessary to open and inspect representative structural components (i.e., destructive investigation) to estimate the extent of mold growth and determine the best remediation approach.

c. When writing your cleaning and remediation plan, think about:

(1) Type of Occupant – Use more conservative guidelines for cleaning mold in high risk population, such as health care facilities or child care centers.

(2) Building Structure - Residential buildings generally have more wood (framing) than commercial buildings. Commercial building may have steel support structures that are less likely to support mold growth and are usually easier to clean if they become contaminated.

(3) Building Use - Special protocols are needed to clean mold in libraries or museums where discarding contaminated contents may not be an option.

(4) Extent of contamination – Small areas of visible mold growth can be cleaned quickly and easily. At the other extreme, buildings with extensive contamination may need to be demolished down to the structural framing for successful remediation.

(5) Potential health effects - Are occupants reporting symptoms? Are there confirmed diagnoses from a physician (vs. self-reported diagnosis)?

(6) Potential for personnel exposure – Define the exposure pathway to ensure remediation addressees the complete process.

(7) Remediation risks - Consider the potential for spreading contamination and possible health impacts to occupants and remediators.

(8) Remediation costs - Can the area be cleaned successfully? What are the costs for remediation vs. relocating employees to another site?

(9) Building plans – Is the contaminated building already scheduled for demolition or extensive renovation?

2. **Cleaning Guide Based on Type of Material**. In general, the success and ease of cleaning building materials is based on their porosity.

a. Non-porous - Materials that do not absorb moisture and will dry quickly, such as metal, glass, hard plastic, tile. These materials can usually be salvaged by thoroughly cleaning with a mild detergent solution. If visibly contaminated, materials should also be HEPA vacuumed before returning to service. Ensure that ALL surfaces of the object(s) are clean.

b. Semi-porous – Materials like wood, concrete, linoleum and vinyl floor covering, vinyl wall covering, hardboard furniture, painted drywall or plaster. These will absorb moisture if exposed to water for a long time. If semi-porous materials are very wet, it is best to discard them. Otherwise, they can be dried thoroughly and cleaned the same as non-porous materials.

c. Porous – Because porous materials readily absorb and retain water, they should almost always be discarded. Examples include carpet, padding, mattresses, stuffed furniture, wicker, fabrics, wallboard, insulation, and ceiling tiles. You can usually save linens, drapes, and clothes after thorough washing or professional dry-cleaning.

(1) Damp wiping and vacuuming will not work because you can't clean the air spaces and channels that are an inherent part of the structure of porous materials. For example, damp wiping gypsum wall board will remove vegetative colonies and mold components on the surface but will not remove colonies or spores that have infiltrated the "nooks and crannies" within and throughout the wallboard. This is why if you wash mold off a wall but take no further action, the mold will usually reappear in a week or so.

(2) The exception to discarding porous materials is when dealing with items that have historic or high monetary value, are irreplaceable, or have sentimental or other inherent value (i.e., furniture, books, art, carpets). Such articles may be cleaned, but it requires special procedures and hiring a specialist is usually the best option. This is very expensive and may not be successful.

d. Following is general guidance for cleaning groups of material that are damaged by clean water and/or have visible mold growth. Check material dryness with a moisture meter. For floors and structural components, a meter with drivable pins is best so that the probes can penetrate to the center of the material.

(1) Papers and Books. Consider photocopying important documents and discarding the originals. You may be able to freeze or freeze dry paper items.

(2) Ceiling tiles & insulation. Discard.

(3) Upholstery & drapes, including upholstered furniture. May require fans, heaters, and dehumidifiers for complete drying. Launder drapes if washable. If foam or stuffing material in upholstered items cannot be dried completely, remove and replace it. If this is not possible, discard the item.

(4) Wallboard, drywall, gypsum. Dry in place and check with moisture meter. If seams separate or swelling occurs, remove and discard. Ventilate wall cavities to ensure drying of support structures.

(5) Wood surfaces (such as floors, furniture, wood structure supports). Dry furniture and flooring thoroughly, using heat with caution so as not to split or crack the wood. Wood paneling should be removed from the wall for drying.

(6) Hard surfaces & porous flooring (metal, plastic, glass, linoleum, vinyl, ceramic tile). Mop or wet vacuum excess water from hard surface, then air or heat dry. It is important to check sub floors with a moisture meter to ensure they are dry. If drying is not successful or flooring warps, cracks, or splits, it will be necessary to completely remove the floor or wall covering.

(7) Carpet and backing/padding. While carpet can be successfully cleaned and dried if done correctly, in most cases it is more economical and practical to remove and discard the carpet and pad. Individual rugs can be washed or dry-cleaned.

(8) Concrete/ block. Fans and/or heaters will probably be needed for thorough drying.

3. **Cleaning Guide Based on Cleaning Method**

a. Damp wiping. For visibly contaminated hard, non-porous surfaces (metal, glass, hard plastic) and some semi-porous surfaces (wood, concrete), mold spores and fragments can usually be removed satisfactorily by wiping the surface and/or scrubbing with water and a mild detergent solution. Use wood floor cleaner for wood surfaces to preclude further damage to the wood. Ensure that all wiped surfaces are completely dried.

b. Wet vacuuming, also called water extraction vacuuming, is used to remove water from floors, carpets, and hard surfaces. For porous materials that have been wet less than 48 hours

and are not visibly contaminated, these vacuums can be useful to speed the drying process. DO NOT use wet vacuums on porous materials after they are dry, as this can actually spread spores. Thoroughly clean and rinse the vacuum, hoses, and attachments after use.

c. HEPA vacuuming. Vacuum all surfaces with a high efficiency particulate air (HEPA)-filtered vacuum after completing the damp wipe step. Ensure items are completely dry before vacuuming. Properly cleaned and vacuumed items can usually be returned to service when the area is cleared for reoccupancy.

HEPA vacuum all room surfaces before collecting clearance samples, making sure to vacuum ledges, cabinet tops, and other hidden surfaces where spores are likely to settle. The HEPA vacuum filter and contents should be double bagged, sealed, and disposed of properly.

d. Disposal. Prior to disposal, secure mold-contaminated waste using the following procedures. Ensure that rags, disposable protective clothing, and similar items are also placed into disposal bags. Dispose of wastes in a sanitary landfill.

(1) Small remediation jobs (i.e., less than 100 square feet (ft^2) - Lightly mist contaminated materials that are being discarded BEFORE disturbing the material. Use a handheld sprayer filled with water or a water/ mild detergent mixture. Misting will minimize generating airborne mold or dust during handling. Place materials into 6-millimeter thick polyethylene (6-mil poly) bags, seal, and damp wipe the outside of the bag before disposal.

(2) Medium/ Large remediation jobs (over 100 ft^2) - Use double 6-mil poly bags or sheeting for discarding contaminated items and construction debris. While inside the containment area, place item(s) being discarded into a bag or onto a sheet. Secure bags with a twist tie or equivalent. Secure sheeting by folding the sheet around the item and taping. Transport bags/sheeting for disposal to the decontamination area. Damp wipe outside of bags or sheeting. Place wiped bag or sheet into second bag/ sheet and secure. Damp wipe the outside of the second layer of polyethylene. HEPA vacuum outside of bag/ sheeting.

4. **Antimicrobial Products (Biocides & Sanitizers)**

a. In general, antimicrobial or biocide solutions are not recommended for most cleanups. While the correct selection and use of these products may be needed in some situations - i.e., if immunocompromised personnel are involved or to eliminate pathogens from gray/black water contamination- the preferred procedure is to remove the mold. Though the biocides will kill the mold, the remaining dead biomass can be allergenic and toxigenic.

b. Since most antimicrobials are irritants, improper application can actually cause additional problems when the area is reoccupied. If biocides are required, prepare and apply according to manufacturer directions, ensure adequate contact time, and ventilate the area. Sample antimicrobial agents are listed in Appendix 13.3-A.

c. Antimicrobial pesticides are used to (1) disinfect, sanitize, reduce, or mitigate growth or development of microbiological organisms; and (2) protect inanimate objects, industrial

processes or systems, surfaces, water, or other chemical substances (e.g., paints, metalworking fluids) from contamination, fouling, or deterioration caused by bacteria, viruses, fungi, protozoa, algae, or slime.

The U.S. Environmental Protection Agency (EPA) regulates antimicrobial agents used on inanimate objects and surfaces as pesticides. More than 5000 antimicrobial products are currently registered with EPA. Ensure that only registered products are used and that those applying pesticides are trained and certified as appropriate for the product used. Go to http://www.epa.gov/ebtpages/pestpesticantimicrobialpesticides.html for more information.

Note that the EPA does not "approve" biocides for mold remediation applications. Beware of remediation companies making such claims. Under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), the EPA has regulatory authority over pesticides and antimicrobial products, but supporting legislation to review specific product applications and issue "approvals" was never adopted or funded.

d. Biocides in ventilation systems. The EPA cautions against using disinfectants and sanitizers in ventilation systems. In a March 2002 letter to the heating, ventilation, air conditioning and refrigeration systems (HVAC&R) associations, the EPA states that these products have not been evaluated for exposure risks to building occupants or applicators. Consequently, disinfectants and sanitizers should not be used in HVAC&R systems UNLESS the product contains directions specific to this application. Details and a copy of the letter are at http://www.epa.gov/oppad001/hvac.htm.

Biocides can be safely and effectively used in HVAC condensate pans and/or coils to prevent microbial growth. Such procedures should be part of the building's HVAC preventive maintenance plan.

e. "Gassing" the building, i.e., using gaseous chlorine dioxide or ozone, is not recommended. There is insufficient data on the efficacy of such wholesale sanitizing. Further, the chemicals themselves are toxic and may cause harm if used inappropriately.

PROTECTION DURING REMEDIATION

1. **Protecting Remediation Personnel**. Anyone performing actions that are likely to disturb or dislodge mold should wear personal protective equipment (PPE) to prevent inhalation of and direct contact with mold. Ensure that personnel are instructed on proper donning and doffing techniques and are enrolled in the appropriate medical surveillance programs.

Gloves – Use gloves to protect against contact with mold biomass (allergens), toxins, and/or cleaning solutions that may irritate the skin. Rubber household gloves are adequate for contact with mold-contaminated materials. If using biocides or strong cleaners, select the glove material appropriate for the chemical (usually nitrile, neoprene, PVC or rubber will be sufficient).

Eye protection – Wear a minimum of tight-fitting goggles to prevent irritation from particulates.

Respirators – Respiratory protection prevents inhaling the airborne mold, spores, and particulates that will be in the remediation area. All personnel wearing a respirator must be trained, fit tested, and enrolled in the Respiratory Protection Program. Wear only respirators approved by the National Institute for Occupational Safety and Health (NIOSH).

- Use an N95 respirator for small area remediations (<10 ft^2).
- If the job involves more than 10 ft^2 but less than about 100 ft^2 of contaminated material, use a minimum N95 air-purifying respirator. A half or full-face air-purifying respirator with HEPA filters may be used based on site-specific conditions.
- If remediating an extensive contaminated area (>100 ft^2) or an area with high concentrations of mold, use a minimum full-face powered air purifying respirator (PAPR) with HEPA filters.

Coveralls, Head, and Foot Coverings – Disposable coveralls keep molds and spores from contaminating personal clothing. Coverings also prevent direct skin contact with the mold biomass. As a minimum, wear protective clothing for remediations of more than 10 ft^2. For large remediations, ensure all openings (i.e., zipper, wrists, leg) are taped.

2. **Protecting Occupants**

a. Scheduling Remediation. Consider scheduling remediation work during minimum occupancy hours to incur the least disruption.

b. Relocation. In most cases, it is not necessary to vacate the building during remediation as long as the work area is properly controlled. However, occupants in the actual work site should be relocated until remediation is complete. During large remediations, offices adjacent to the enclosure should be vacated to remove occupants from the noise, construction traffic, and disruption associated with the work.

(1) If contamination results from gray or black water, especially in sewage situations, occupants should be removed from the building until cleanup and disinfection are complete.

(2) Work with the local occupational medicine department to determine if occupants with health problems should be relocated until cleaning/ remediation is complete and the building is cleared for reoccupancy. Health care providers may recommend temporary relocation based on individual medical evaluations. For example, people with hypersensitivity pneumonitis, severe allergies, asthma, immune suppression, or chronic inflammatory lung diseases are at higher risk and may require relocation or other accommodations during remediation. Section 13.4 discusses medical evaluations specific to mold contamination events.

c. Containments (enclosures) are used to prevent the release of mold, mold spores, and remediation debris into the surrounding building areas and into the environment. Although the remediation procedures are loosely associated with the size of the contamination area, you have to consider actual mold concentrations. Small contaminated areas do not usually need to be enclosed before removal. If an area is heavily contaminated – i.e., "covered" with mold - there is a high potential for mold/spore release and subsequent spread of contamination to other areas. In this situation, an enclosure would be appropriate.

(1) Table 13.3-1 provides minimum containment procedures. Any remediations with high concentrations of mold and/or extensive contamination areas should institute the strictest containment procedures. Also consider more extensive containments if demolition actions (i.e., cutting, hammering) are required to remove contaminated material.

(2) If containments are properly constructed, the polyethylene sheeting will billow inwards when placed under negative pressure. If the sheeting billows outward or flutters, the containment is not properly sealed. Stop work until the containment is restored to full negative pressure.

Table 13.3-1. Mold remediation containment guide.

PROCEDURE or ACTION	CONTAMINATED AREA, ft^2			HVAC[1]
	< 10	10-100	>100	
Remove occupants from work area[2].	✓	✓	✓	✓
Remove occupants from adjacent areas[2].			✓	✓
No containment needed.	✓			
Seal off work area with 6-mil polyethylene sheeting (i.e., critical barrier)[3]. Seal seams.		✓	✓ double poly	✓
Seal off all supply and return air ducts and doors into/out of the contained area.		✓	✓	
Secure ventilation system.			✓	✓
Place work area under negative pressure using exhaust fan(s) equipped with HEPA filters. Exhaust air outside.		✓	✓	✓[4]
Use airlocks into/out of the work area.			✓	✓[4]
Establish decontamination room outside of the enclosure.			✓	✓[4]
Use dust suppression methods (misting) on any material or object to be removed, cut, or discarded.	✓	✓	✓	✓
Dispose of contaminated material and cleaning rags per Disposal guidelines.	✓	✓	✓	✓
Mop or wipe down area after cleaning/removal is complete.	✓	✓	✓	✓
After damp wiping, clean the same area with a HEPA-filtered vacuum		✓	✓	✓
Visually inspect work area for cleanliness (no dust).	✓	✓	✓	✓
Conduct clearance sampling before removing containment.			✓	✓

[1] HVAC = heating, ventilation, and air-conditioning system.
[2] Consult occupational medicine physician. Some occupants may be removed based on medical conditions such as recent surgery, chronic lung disease, immunosuppression, etc.

[3] Cover area with poly sheeting from ceiling to floor. Tape (or otherwise attach) poly to the framing or room perimeter. Tape all seams shut. Provide slit entry with covering flap. Maintain high negative pressure using HEPA filtered fan. Block supply and return vents in the contaminated area.
[4] If contaminated area is >30 ft^2.

THE MOLD REMEDIATION WHEEL

1. The Mold Remediation Wheel, Figure 13.3-1, consolidates the guidance discussed in this section and provides remediation procedures, protection recommendations, and engineering controls in a single page. The guidance is based on total contaminated area - simply as a way of delineating job complexity. There is no known correlation between total contaminated area and occupant health effects.

The Mold Remediation Wheel can be viewed, saved, or printed from http://www-nehc.med.navy.mil/downloads/ih/ihfom/MR_wheel.pdf

2. The remediation wheel is adapted from The Education Safety Association of Ontario (ESAO), *Mould Growth Prevention and Remediation* (http://www.esao.on.ca/scriptcontent/index.cfm), which is based on the EPA guidance in *Mold Remediation in Schools and Commercial Buildings*. Figure 13.3-1 has been further modified to incorporate additional guidance and best practices from the New York City *Guidelines on Assessment and Remediation of Fungi in Indoor* Environments; Institute of Inspection, Cleaning and Restoration Certification Standard IICRC S500; the Manitoba Department of Labour & Immigration guidelines; Canada Health guide; and the ACGIH book *Bioaerosols: Assessment and Control*. Full citations are in the References (section 13.8).

3. The wheel is intended to be a quick reference tool for planning mold remediation actions based on the type of material that has been water damaged and/or contaminated. As with any tool where information is grouped into broad categories, refer to the chapter text and references for complete discussion.

4. How to Use the Mold Remediation Wheel (Figure 13.3-1)

Starting in the center, choose the type of material that has been damaged. Stay within the quadrant for the selected material and move outward toward the circle periphery. New conditions, choices, or information are added with each new ring.

Center – START

1st ring (white) = SELECT TYPE OF MATERIAL

2nd ring (yellow) = ACTION 24-48 HOURS - If response is within 48 hours of clean water damage and there is no visible mold growth, match the numbers in this ring with the response actions in the yellow box below the wheel.

3rd ring (white) = ACTION >48 HOURS – If response is more than 48 hours after clean water damage or if there is visible mold growth, move to the 4th ring.

4th ring (white) = CONTAMINATION AREA - Determine the extent of contamination. The general categories are:

Less than 10 square feet [<10 ft^2] (e.g., a ceiling tiles; small area of wallboard)

Between 10 ft^2 and 100 ft^2 [10 –100 ft^2] (e.g., 1-3 wallboard panels)

More than 100 ft^2 [>100 ft^2] (e.g., the whole wall)

5th ring (blue) = CLEANUP / REMEDIATION METHODS - Match the letters in this ring with the remediation/ cleanup methods shown in the blue box below the wheel.

6th ring (pink) = PPE – Match the letters with the personal protective equipment (PPE) codes in the pink box below the wheel.

7th ring (green) = CONTAINMENT - In the outer ring, determine if containment is needed and if so, what level. Match the letter in this ring with the containment code in the green box below the wheel.

QUALIFIED PERSONNEL

There are no specific regulations that govern mold remediation or define qualifications for personnel who clean and remediate contaminated areas. In general:

Small and medium isolated areas (e.g., less than 3 sheets of wallboard) – Remediation can be done by maintenance personnel who have been specifically trained on mold contamination cleaning procedures, potential hazards, and proper protective equipment.

Large areas (over 100 ft^2; e.g., an entire wall in an office) and HVAC systems – Only personnel specially trained in mold contamination cleanup and disposal procedures should do large scale remediation. Further, an occupational safety and health professional should oversee the remediation, including reviewing protocols and contract requirements.

MOLD/ INDOOR AIR QUALITY CERTIFICATIONS

There are certifications that cover the range from indoor air quality generalist to very specific titles. Below are the sponsoring organizations and certifications they offer. We have listed only organizations whose certification requirements include as a minimum: education and/or experience to qualify; written examination; and ongoing training and recertification programs.

DISCLAIMER: This list is provided as an information resource to assist Navy Industrial Hygienists in making an informed decision about mold remediators' qualifications. Listing does

not imply endorsement by the Department of Defense, the Navy, or the Navy Environmental Health Center, nor does it mean that these certifications have merit.

American Indoor Air Quality Council – Certified IAQ Consultant (CIAQC); Certified IAQ Investigator (CIAQI); Certified IAQ Manager (CIAQM™); Certified Microbial Consultant (CMC™); Certified Microbial Investigator (CMI™); Certified Microbial Remediation Supervisor (CMRS™); Certified Microbial Claims Adjuster (CMCA™)
http://www.iaqcouncil.org/Certification-Courses/Course-Descriptions/certification-courses.htm

Association of Energy Engineers – Certified Indoor Air Quality Professional (CIAQP®)
http://www.aeecenter.org/certification/

Certified Mold Inspectors and Remediators Institute – Certified Mold Inspector, Certified Mold Remediator, Certified Mold Contractor, Certified Environmental Inspector, Certified Home Inspector, Certified Environmental Hygienist, Certified Commercial Hygienist, Certified Residential Hygienist, Certified Property Mold Specialist, Certified Toxic Mold Investigator,
http://www.certifiedmoldinspectors.com/

Indoor Air Quality Association – Certified Mold Remediator (CMR); Certified Indoor Environmentalist (CIE); Certified Mold Loss Prevention Specialist (MLP);
http://www.iaqa.com/

Indoor Environmental Standards Organization – Certified Residential Mold Inspector (CRMI)
http://www.iestandards.org/Certification/certification.aspx

Institute of Professional Environmental Practice – Qualified Environmental Professional (QEP); Environmental Professional Intern (EPI)
http://www.ipep.org/flash/home.html

National Air Duct Cleaners Association - Air Systems Cleaning Specialist (ASCS)
http://www.nadca.com/certification.htm

CLEARANCE SAMPLING

The New York City Department of Health *Guidelines on Assessment and Remediation of Fungi in Indoor Environments*, EPA's *Mold Remediation in Schools and Commercial Buildings,* and the ACGIH *Bioaerosols: Assessment and Contro*l provide guidance on assessing and remediating fungal contamination in buildings. Though there are differences in the documents, they all agree that visible fungal growth should not be present in indoor occupied space, regardless of the number or type of fungi. Consequently, the goals of remediation are to (1) completely remove microbial reservoirs, and (2) thoroughly clean the air and all surfaces in the affected area.

Successful remediation has been defined as reoccupancy without subsequent complaints or reported symptoms associated with fungal contamination. Sampling may help determine the likelihood of achieving this success.

- Before sampling in any building, be sure there is a clear plan for data evaluation. Understand the sampling limitations and what the results may – or may not – mean.

- General area, HVAC system, and/or surface sampling both before and after cleaning may be useful to show remediation success. Develop a sampling plan that explains where and how to sample, pass-fail criteria, and what action is required if samples "fail."

- Remember that the area will not be sterile even after a successful remediation! In general, you are looking for a decrease in the number and types of fungi.

- Clearance sampling is not always needed, especially for small remediation jobs. Sampling should be done when you must:

  - Assure personnel that mold was successfully removed.

  - Document that the containment was not compromised.

  - Show that a remediated area is ready for occupancy.

  - Remediate more than 10 ft^2 of the HVAC system. After the ventilation system is cleaned and visually inspected, sample in the ducts, at the supply registers, and/or in the ambient spaces served by the remediated system to make sure the ducts are clean and adjacent spaces are not contaminated.

1. **Clearance Procedure** (see Figure 13.3-2 for process diagram).

a. Perform a visual inspection of the cleaned, remediated area to ensure absence of visible fungal growth. It may be helpful to do a "white glove inspection" – that is, use a clean white glove, sterile cotton gauze square or equivalent. Wipe across surfaces to check for dust or debris. This is particularly helpful for quickly checking ledges, recessed surfaces, and out-of-the-way areas. Carefully inspect hard to reach spots since they may have been missed or insufficiently cleaned during remediation.

b. Any areas or surfaces that do not pass the visual inspection must be re-cleaned, i.e., damp wipe with water/detergent, then HEPA vacuum.

c. If the remediated area includes a containment, conduct clearance sampling with the containment in place. Leave negative air systems running so any remaining contamination will not be distributed.

d. Collect air samples inside the work area using aggressive techniques (i.e., use a leaf blower to move the air in the room before sampling). Total spore counts (e.g., Air-O-Cell

cassettes; button sampler; IOM sampler; 37 mm cassette; Cyclex-D impactor, etc.) are sufficient for clearance sampling except in very unusual cases.

e. Collect air samples outside, preferably at the fresh air intake that supplies the remediated area, to use as ambient controls for comparing with inside results.

f. You may want to collect control samples in non-contaminated areas of the building that can be used for comparing the inside contaminated/remediated with a comparable inside non-contaminated/non-complaint area.

g. Swab or tape samples are usually sufficient to check for adequate surface cleaning.

2. **Interpreting Clearance Sample Results**

a. Inside sample results should be less than or equal to outside samples for total spores, rank order, and biodiversity of taxa.

b. In pre- and post-remediation sampling comparisons, post results should show essentially zero spores. As a minimum, post-cleaning results should be significantly less than pre, with no indicator species present.

c. Indicator species [*Aspergillus, Penicillium, Chaetomium, Stachybotrys, Memnoniella*] in inside samples should be absent or lower than outside control samples.

For practical purposes, finding 1 or 2 spores of an indicator species inside during clearance sampling should not automatically trigger re-cleaning. However, because the mere presence of some indicator species, like *Stachybotrys*, may cause employee concern, it may be prudent to repeat the cleaning protocol until no spores are found during clearance sampling. The investigating team should determine whether zero (0) indicator species spores will be required to pass the clearance test. Document the decision in the sampling plan along with the criteria for clearance.

d. If indoor total spore concentrations are greater than outdoor results, or if there are reversals/differences in rank order and biodiversity, this indicates that fungal reservoirs may still be present in the work area. Inspect the area for visible contamination. If mold is found, repeat the remediation protocol for the affected area and contents. If unable to locate visible contamination, search for hidden mold reservoirs and, if found, repeat the complete protocol.

e. In general, if inside sample results are less than or equal to outside results (total spores, rank order, biodiversity of taxa, and indicator species), the area can be reoccupied. Actual reoccupancy criteria will be specified in the remediation plan.

f. Medical Support Sampling. In cases with medical diagnoses that indicate suspected or specific fungi, clearance sampling should include viable sample collection (e.g., Andersen or Biosampler) so that recovered fungi can be speciated.

If diagnosis is linked to allergic symptoms, total spore counts are essential for clearance sampling because analysis counts all particulates. Remember that dead mold spores can still elicit allergenic responses.

If a genetic signature (target specific primer) is available for a suspected causative fungus, polymerase chain reaction (PCR) testing may also be useful.

OTHER POST-REMEDIATION TESTS

1. Carpet. If carpet was cleaned rather than removed, clearance sampling should include collecting representative samples with a microvacuum on a 1 ft. x 1 ft. template. Sample results should show spore counts, rank order, and biodiversity less than pre-cleaned carpet samples.

Remember that it is almost always best to remove and discard water-damaged carpet. Carpet damaged from clean water may be successfully cleaned if it is properly dried within 24-48 hours and has no visible growth. For gray water damage, salvaging carpet will depend on the extent of damage and the responder's professional judgment. Without exception, discard carpet damaged by black water.

2. Surface Cleaning Effectiveness. If you need to confirm surface cleaning effectiveness for decontamination of non-porous or semi-porous materials, collect surface samples using scotch tape, swabs, or wipes. Surfaces should be spore-free.

3. Moisture Testing. Moisture meters can be useful to monitor the drying process for wood (e.g., flooring; structural supports; siding), concrete, brick, carpet, wallboard, and exterior insulation and finish systems (EIFS).

AFTER THE REMEDIATION: ENSURING SUCCESS

Mold removal and decontamination is not finished after the remediation. Follow-up inspection is required to ensure that contamination conditions do not recur.

Reinspect the remediated area every 2-3 weeks until satisfied that water intrusion has stopped and mold growth is unlikely to recur. Look for any new water sources. Also check to ensure that porous/semi-porous building materials that were cleaned remain free of visible contamination.

Provide update reports to employees/occupants until the investigation team determines that the contamination has been successfully remediated. Provide a final report to occupants when remediation is complete.

3. Ensure there is an appropriate preventive maintenance plan for the HVAC system and that the building owner understands the importance of strict maintenance.